9

THE TAWONGA FAULT, NORTH-EAST VICTORIA

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Abstract

The Tawonga Fault has been mapped between Morse's Creek S. of Bright, and the Mitta Mitta Valley. Two periods of movement have occurred; the earlier, a wrench faulting, is of Palaeozoic age, the latter was a low angle thrusting in which young alluvials were involved, and is of Tertiary to Pleistocene age. This younger movement was associated with the Tertiary warping in E. Victoria.

Introduction

In a report of geological surveys for the (then) proposed Kiewa Hydro-electric Project, J. G. Easton (1937) stated: 'One of the first physiographic features which strikes one's imagination on visiting this area is the sudden and marked termination of the . . . river flats of the Kiewa Valley, and this, I am convinced, is to be explained by a major fault trending along the foot of the Bogong spurs in a north-easterly direction'.

When, in 1946, the final layout for the No. 4 Development of the Kiewa Project was adopted, it seemed probable that if the fault suggested by Easton did in fact exist, it could influence tunnel construction. The writer therefore undertook field work in 1948 which confirmed the existence of Easton's assumed fault. Subsequently, in the latter part of 1948, the fault was exposed in the No. 4 Tail Race Tunnel. Further field work in 1954 and 1958 traced the fault as far as Chinaman's Creek, near Bright, in the SW., and the Mitta Mitta Valley in the NE. This fault is known as the Tawonga Fault.

Topographic Expression of the Tawonga Fault

Easton (op. cit.) noted a strong physiographic lineament extending from the Ovens Valley, along Symmond's and Mountain Creeks, through the Mitta Mitta Valley and along Cudgewa Creek to the Murray R. The more detailed observations by the present writer showed that this lineament can be traced with certainty to the NE. only as far as the W. branch of Snowy Creek, to the W. of the Mitta Mitta Valley. Beyond this, parallel lineaments such as that of Cudgewa Creek occur, but do not occupy the Tawonga Fault; rather, these occupy *en echelon* structures. The Ovens Valley crosses the Tawonga Fault almost at right angles; to the SW. Smoko Creek and Chinaman's Creek, and to the NW. Symmond's Creek, Mountain Creek, and Trapper's Creek all follow the fault.

A marked change in elevation occurs across the Tawonga Fault (see Pl. X, fig. 1). In the Kiewa area, the youthfully dissected terrain SE. of the fault has an average elevation of 5800 ft., while to the NW. of the fault, the divides have an average elevation of 4000 ft. This latter area is marked by a much more intricately dissected topography, and the Ovens, Kiewa and Mitta Mitta Valleys have reached early maturity. The topographic evidence suggests uplift of the SE. block of not more than 1800 ft., with rejuvenation of the drainage on this block. The Bogong High Plains represent a fragment, as yet undissected, of the pre-uplift terrain.

Within the Upper Kiewa and Upper Big R. Valleys, evidence of several periods of stillstand is seen in valley in valley structure. Strongly developed benches occur at elevations of 5600, 5400, 4600, 4200 and 3600 ft. Traces of alluvium are to be found on some of these benches. To what extent this valley in valley structure is due to the uplift of the fault, or to the Tertiary warping, is difficult to assess, and further investigation will be required to resolve this point.

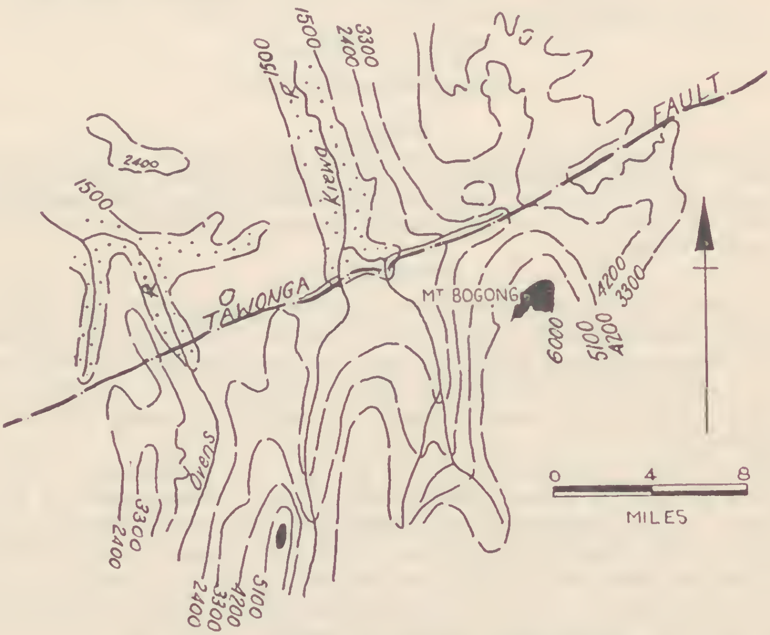

Fig. 1.—Topographic Expression of Tawonga Fault.

Geology

Field Relationships

At the SW. section of the area mapped (Fig. 2), on the divide between Morse's Creek and the Ovens R., Upper Ordovician greywackes occur on both sides of the fault. Strike of the fold axes is constant at N. 60° W., but there is a strong contrast in attitude of bedding in the two blocks. In the SE. block, folding is close and relatively complex, whereas in the NW. block dip is constant at 60° with the folding broad, open, and lacking complexity. Well to the SE. of the Tawonga Fault in this area the fold axes have a more or less uniform trend of N. 10° W., the swing to N. 60° W. occurring as the fault is approached.

In the valley of Symmond's Creek, crumpled and crushed slates and greywackes pass to the E. into low grade chlorite and biotite schists. Here, the sediments and schists abut against biotite sillimanite cordierite gneiss, intensely mylonitized and brecciated, which, on the Bogong High Plains is transitional from high grade schists. Basic lamprophyre dykes intrusive into the gneiss of Symmond's Creek have been brecciated but not mylonitized. A pink granodiorite at Young's Gap is terminated to the NW. by the Tawonga Fault. This granite has been reduced to a protomylonite by the fault movement.

At Mt. Beauty township, because of the economic considerations, the study of the Tawonga Fault was most detailed. In this area the alluvium of the Kiewa Valley, a poorly consolidated boulder conglomerate, terminates against the mylonitized and brecciated gneiss. In an endeavour precisely to locate the plane of the Tawonga Fault, 3 diamond drill holes were sunk in July 1948. Of these, bore 479 returned crushed gneiss to 200 ft., and bore 480 to 260 ft. Below these depths the varied lithology and rounded nature of the core fragments suggested alluvial material. Bore 481 was closed at shallow depth before any useful information was obtained.

Fig. 2.—Map of the Tawonga Fault.

The No. 4 Tail Race Tunnel portalled in the boulder conglomerate, and was driven in this material for a length of 491 ft. from the survey datum (66 ft. outside the portal). At this chainage, brecciated gneiss appeared in the back of the tunnel, overlying the alluvium (see Pl. X, fig. 2). As tunnelling progressed, the gneiss occupied an increasing proportion of the face to chainage 653 ft. where the fault plane passed through the invert of the tunnel. Accurate surveys in the tunnel showed that for this limited section, the fault plane had strike N. 48° E., with dip 16° SE. That the Tawonga Fault here is a low angle thrust was clearly indicated.

In the valleys of Mountain and Trapper's Creeks, the gneiss of the NW. block abutted against medium to high grade schists and granites of the SE. block. NE. from the West Branch of Snowy Creek, in the Upper Ordovician sediments, no evidence of the Tawonga Fault was observed.

The Crush Zone of the Tawonga Fault

Associated with the Tawonga Fault is a belt, up to 2000 ft. in outcrop width, of mylonitized and brecciated rock. This belt consists of bands of mylonite and cataclasite (Fig. 3), of varying width, which together with the more normal rocks, have been subjected to later brecciation. Relatively wide zones of gouge occur with

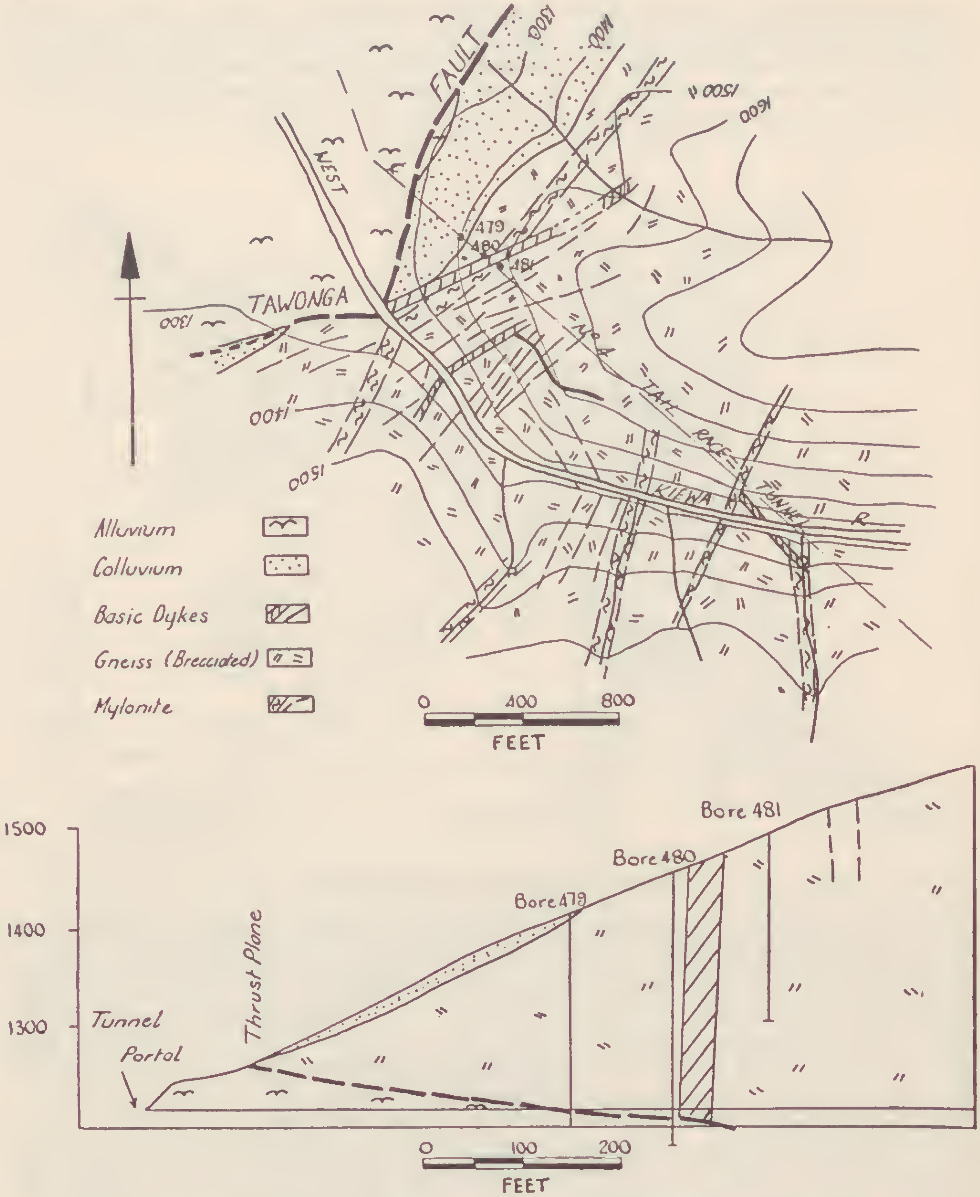

FIG. 3.—Map of Part of Crush Zone of Tawonga Fault, Mt. Beauty Township, with section along the No. 4 Tail Race Tunnel.

the breccia. It is important to note that the lamprophyre dykes have been brecciated, but not mylonitized.

The bands of mylonite generally have a strike varying between N. 40° E. and N. 50° E. The foliation of the mylonites is parallel to the walls of the bands. Petrofabric studies of the quartz and mica of the mylonites (Figs. 4a, 4b) show typically an orientation due to flattening. These studies show orientation by a compressive stress acting horizontally in a SE.-NW. direction. The attitude of the mylonite zones (Fig. 4c), as well as the fabric, are incompatible with the stress field requisite for low angle thrusting. Moreover, the myonites and cataclasites result from faulting under physical conditions very different from those which would produce breccia and gouge. This evidence leads to the conclusion that there have been at least two distinct movements on the Tawonga Fault, at two widely separated periods of time. The earlier wrench movement occurred at considerable depths, with elevated tem-

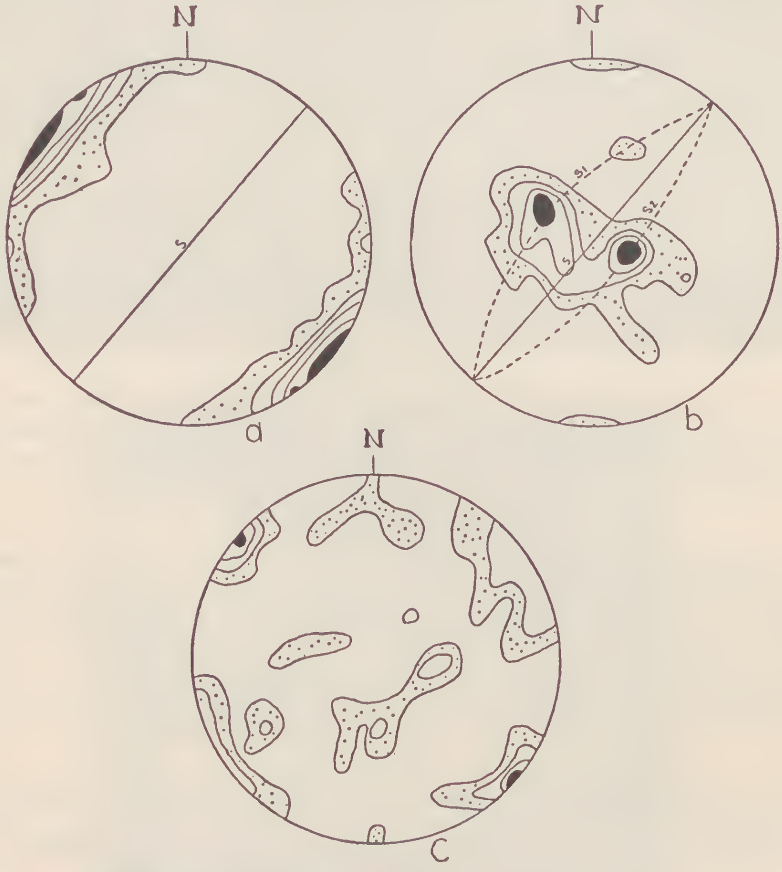

FIG. 4.—Mylonites of the Tawonga Fault.
4a.—Poles to 200 cleavage planes of mica. Contours > 7–5–3–1%.
4b.—Optic axes of 207 quartz crystals. Contours > 8–6–4–2%. Specimen for 4a and 4b granodiorite protomylonite, Young's Gap.
4c.—Poles to 150 mylonite bands, crush zone of Tawonga Fault. Contours > 8–6–4–2%.

peratures to produce the mylonites (Hsu 1955), while the later low angle thrusting occurred at shallow depths.

Age of the Faulting

The first movement apparently pre-dated the intrusion of the Upper Devonian lamprophyre dykes, since these show no deformation ascribable to the earlier movement. The movement post dated the West Kiewa Thrust, of Benambran age, since this has been displaced laterally by the Tawonga Fault. The Tawonga Fault also post dates the intrusion of the granodiorite of Young's Gap, Mountain Creek, and the East Kiewa, of epi-Silurian age. The first Tawonga movement was therefore probably epi-Silurian in age, and associated with the Bowning orogeny.

The later movement is more difficult to date exactly. Thrusting probably began before the development of the present stream system, and continued for a sufficiently great length of time for the alluvials to have been involved. Any suggestion that the boulder conglomerate might be a Permian glacial tillite can be discounted by the presence in the conglomerate of boulders of High Plains Older Basalt, the rounded nature of the boulders, and the virtual absence of clay size particles from the matrix. Since the alluvials are continuous with those currently being deposited, the latest movement on the Tawonga Fault cannot be older than Pleistocene, although the thrusting probably commenced much earlier in the Tertiary.

There is considerable evidence of Tertiary tectonic activity in the area dating from the extrusion of the Older Basalts. The warping which occurred on a NE.-SW. axis, and which passes through the Baw Baw plateau and the Bogong and Dargo High Plains, is probably the most important expression of this activity. The presence of tensile conditions parallel to this axis at the time of extrusion of the Older Basalts is indicated by the main centres of eruption, in the area studied, falling on lines with this orientation.

Conclusions

The Tawonga Fault is to be regarded as one of the major structures of NE. Victoria. The fault has undergone at least two periods of movement, one epi-Silurian, the other Tertiary to Pleistocene. The younger movements, of the low angle thrust type, resulted in the elevation of the up-thrust block by some 1800 ft.

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Explanation of Plate X

Fig. 1.—Termination of the Lower Kiewa Valley on the Tawonga Fault. Note rapid ascent from Kiewa Valley (1200 ft.) to Bogong High Plains.

Fig. 2.—The Tawonga Fault, No. 4 Tail Race Tunnel. Gneiss overlies alluvium, the thrust plane showing midway down the face.